Physics of Metals and Metallography 2017 vol.118 N4, pages 341-345

Magnetic behavior of the nanophase of YbNi2 alloys

Ivanshin V., Gataullin E., Sukhanov A., Ivanshin N., Rojas D., Fernández Barquín L.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2017, Pleiades Publishing, Ltd.Variations in magnetic properties of the heavy-fermion YbNi2 alloy when milled in a high energy ball milling system have been investigated. The ferromagnetic transition (TC = 10.4 K) in the initial sample almost vanishes after milling, which leads to the appearance of a magnetic transition at T* = 3.2 K in nanocrystallites. Before milling, processes of spin–lattice relaxation of the Orbach–Aminov type with the participation of the first excited Stark sublevel of the Yb3+ ion located at 75 K are dominating in the electron spin dynamics in the paramagnetic phase of the alloy. A comparative study of the temperature dependence of the magnetic properties and spectra of electron paramagnetic resonance in poly- and nanocrystalline samples indicates the existence of a magnetic inhomogeneity of the compound arising upon milling.

http://dx.doi.org/10.1134/S0031918X17040044

Keywords

electron paramagnetic resonance, heavy fermions, magnetic susceptibility, nanocrystallites

References

[1] D. P. Rojas, L. Fernández Barquín, J. I. Espeso, J. Rodríguez Fernández, and J. Chaboy, “Reduction of the Yb valence in YbAl3 nanoparticles,” Phys. Rev. B: Condens. Matter Mater. Phys. 78, 094412 (2008).

[2] A. V. Chadwick, I. J. F. Poplett, D. T. S. Maitland, and M. E. Smith, “Oxygen speciation in nanophase MgO from solid-state 17O NMR,” Chem. Mater. 10, 864–870 (1998).

[3] G. Singh and S. V. Bhat, “Effect of size reduction on magnetic ordering in Bi0.2Sr0.8MnO3,” J. Appl. Phys. 115, 17E130 (2014).

[4] K. Baberschke, “From local moment EPR in superconductors to nanoscale ferromagnets,” J. Supercond. Nov. Magn. 19, 77–84 (2006).

[5] E. M. Gataullin, V. A. Ivanshin, D. P. Rojas, and L. Fernández-Barquin, “Electron spin resonance of the ferromagnetic YbNi2 alloy,” JPS Conf. Proc. 3, 012028 (2014).

[6] D. P. Rojas, L. Fernández Barquín, J. Rodríguez Fernández, J. I. Espeso, and J. C. Gómez Sal, “Size effects in the magnetic behaviour of TbAl2 milled alloys,” J. Phys.: Condens. Matter 19, 186214 (2007).

[7] D. P. Rojas, L. Fernández Barquín, J. Rodríguez Fernández, J. I. Espeso, and J. C. Gómez Sal, “Magnetization and specific heat of nanocrystalline rareearth TbAl, TbCu and GdAl alloys,” J. Phys.: Conf. Ser. 200, 072080 (2010).

[8] D. P. Rojas, L. Fernández Barquín, C. Echevarria-Bonet, and J. Rodríguez Fernández, “YbNi: A heavy fermion ferromagnet,” Solid State Commun. 152, 1834–1837 (2012).

[9] G. K. Williamson and W. H. Hall, “X-ray line broadening from filed aluminum and wolfram,” Acta Metall. 1, 22–31 (1953).

[10] V. A. Ivanshin, J. Deisenhofer, H.-A. Krug von Nidda, A. Loidl, A. A. Mukhin, A. M. Balbashov, and M. V. Eremin, “ESR study in lightly doped La(1 - x)SrMnO,” Phys. Rev. B: Condens. Matter Mater. Phys. 61, 6213–6219 (2000).

[11] P. Schlottmann, “Electron spin resonance in heavyfermion systems,” Phys. Rev. B: Condens. Matter Mater. Phys. 79, 045104 (2009).

[12] E. Abrahams and P. Wölfle, “Electron spin resonance in Kondo systems,” Phys. Rev. B: Condens. Matter Mater. Phys. 78, 104423 (2008).

[13] A. Ramirez and P. Coleman, “Theory of the electron spin resonance in the heavy fermion metal ß-YbAlB4,” Phys. Rev. Lett. 112, 116405 (2014).

[14] D. S. Rodbell, “Ferromagnetic resonance absorption linewidth of nickel metal. Evidence for Landau–Lifshitz damping,” Phys. Rev. Lett. 13, 471–474 (1964).

[15] M. Domke, C. Laubschat, E. V. Sampathkumaran, M. Prietsch, T. Mandel, G. Kaind, and H. U. Middelmann, “Bulk and surface valence in YbPdx compounds,” Phys. Rev. B: Condens. Matter 32, 8002–8006 (1985).